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Leveraging the Public School System to Combat Adolescent Obesity: The Limits of Arkansas's Statewide Policy Initiative

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Abstract

Purpose: This study assessed the effectiveness of one of the earliest statewide policy initiatives to address obesity via schools—Arkansas's Act 1220 of 2003—on adolescent obesity. The Act required public schools in Arkansas to conduct body mass index (BMI) screening and reporting, restrict access to vending machines and establish physical education and nutrition standards.

Methods: To determine the effect of Act 1220 as a whole, this study analyzed data representative of adolescents in grades 9-12 from the Youth Risk Behavior Survey (YRBS) using the quasi-experimental method of difference-in-differences. Changes in adolescents' weight outcomes in Arkansas before (1999 and 2001) and after (2005, 2007 and 2009) the implementation of Act 1220 were compared to changes in weight outcomes for adolescents from the neighboring state of Missouri across the same time period.

Results: Arkansas's Act 1220 did not significantly influence adolescents' BMI-for-age z-scores (zBMI) (-0.017; 95% confidence interval [CI] [-0.097, 0.063]; p=.68). Further, the Act did not lead to significant reductions in zBMI among adolescents who were either overweight (-0.003; 95% CI [-0.043, 0.036]; *p*=.86) or obese (-0.010; 95% CI [-0.070, 0.051]; *p*=.75). Results remain robust to adjustments for self-report bias in height and weight as well as a set of alternative comparison states.

Conclusions: Preventing adolescent overweight and obesity is unlikely to occur through such large-scale policy initiatives alone.

Keywords: obesity prevention; adolescents; schools; difference-in-differences; Arkansas

Implications and Contribution

Statewide initiatives addressing obesity via schools have gained traction across the country, yet evidence of their effectiveness remains elusive. This study generates new evidence that a statewide initiative implemented in Arkansas in 2003 to prevent childhood obesity via schools, known as Act 1220, was unrelated to adolescents’ weight outcomes.

Leveraging the Public School System to Combat Adolescent Obesity: The Limits of Arkansas's Statewide Policy Initiative

Public schools across the United States have assumed an increasingly prominent, albeit often controversial, role in influencing children's health. In recent years, public schools have tackled one health problem that, to this day, remains highly intractable: childhood obesity [1-6]. Addressing obesity via schools, though controversial, occurs for good reason. Schools possess the regulatory authority to influence, both directly and indirectly, children's eating and physical activity behaviors during the school day [1]. And this influence is far-reaching—over 50 million children attend public elementary and secondary schools across the United States [7].

Arkansas's Act 1220 was one of the first pieces of state legislation positioning public schools on the frontlines in the fight against obesity [8, 9]. At the time of the Act's passage in 2003, over 16.4% of children aged 10-17 in Arkansas were classified as overweight, two percentage points above the national average (14.8%) [10]. With strong bipartisan support, the Act's key provisions called for [11]:

1. Annual body mass index (BMI) screenings for all public school students and reports with BMI information sent to students' parents;
2. The prohibition of elementary school students' access to vending machines; and

3. The establishment of nutrition and physical education standards for public schools via district nutrition and physical activity committees as well as a Child Health Advisory Committee (CHAC).

Evaluations have reported that a leveling of rates of obesity and overweight occurred three years after the Act was implemented [9, 12]. Further, three quarters of kindergarteners who were obese when Act 1220 was implemented remained obese ten years later in 10th grade [13]. Finally, a recent evaluation of one of the most controversial provisions of the Act, BMI screening and parental reporting requirements, demonstrated that there was no significant relationship between screenings that occurred later in adolescence and weight outcomes or exercise and dietary intake behaviors [14].

In light of these findings, however, a key question still remains unanswered: Did Act 1220, as a whole, affect adolescents' weight outcomes? Disentangling the underlying influence of the Act's provisions, apart from other confounding factors, allows us to determine whether scarce educational and public health resources that were invested in implementing the Act achieved their intended impacts. Though extant evidence demonstrates correlational links between state-level policies and childhood obesity [15, 16], causal evidence remains much more elusive.

Moreover, analyzing the effectiveness of Arkansas's Act 1220 as a whole allows a more realistic picture of the real-world effects of multi-pronged obesity prevention strategies as they are enacted on the ground in schools.

Finally, analyzing how adolescents specifically respond to such policies broadens the knowledgebase on the effectiveness of school-based health policies which has tended to be dominated by studies focused on children in younger age groups.

Accordingly, the aim of this study is to examine the effect of Act 1220, as a whole, on adolescent weight outcomes.

Arkansas's Act 1220 and Obesity Prevention

Conceptual Foundations. Conceptually, Arkansas's Act 1220 aimed to prevent childhood obesity via both individual and population-based approaches [17]. The first approach, screening children for their BMI at school and reporting the results home to parents, targeted individual children and their parents. This strategy was designed to alter and prevent obesity by sending tailored messages to overweight and obese children and their families, thereby providing signals about their susceptibility to obesity and its negative health consequences. The messages provided to parents consisted of confidential letters that schools sent home, known as Child Health Reports which reported not only their child's BMI, but also included guidelines from the American Academy of Pediatrics encouraging exercise and consumption of healthy foods. Thus, when viewed within the framework of the Health Belief Model (HBM) [18], sharing BMI information served as a "cue to action"—a trigger or nudge—which, if considered seriously, could have motivated parents to change their children's exercise and or eating behaviors. Likewise, if parents shared BMI information with their children, children themselves could have been motivated to change their behaviors.

The second approach under Act 1220 aimed to alter the obesogenic (i.e., obesity promoting) environments that all children were exposed to in their schools. Addressing childhood obesity via altering children's nutritional and physical education environments is theoretically grounded in the notion that obesity is a "…response to an abnormal or inappropriate environment" [19]. Thus, banning or restricting access to vending machines in schools limited children's access to low-quality foods (i.e., an "inappropriate" food environment), while setting nutritional standards for foods sold in schools expanded access to higher quality foods. Further, setting physical education standards ensured that, at minimum, all children were in environments that provided developmentally appropriate instruction on ways to maintain physical fitness.

Implementation in Practice. Act 1220's main provisions were implemented with relatively strong fidelity [9]. For example, BMI screening and reporting was implemented across schools widely with nearly 94% of the state's public school students participating (421,973 of 449,485) in the initial 2003-2004 roll out year [8], while 98% of public schools participated in screening and reporting in 2015-2016 [13]. Also, based on last summative evaluation report of Act 1220 from 2010, while vending machines were still present in public schools, 77% of those schools limited students' access to them during lunchtimes and nearly 66% of districts developed policies to ban junk foods in those machines, a significant increase since 2004 (18%) [20]. At the same time, though the vending machine ban was specific to elementary schools, Arkansas's high schools restricted access to vending machines during before school and after lunch hours as well as altered the contents of those machines (i.e., increased availability of water versus soda) [21]. Finally, physical activity standards and assessments were more commonplace with 45% of districts having policies on assessing children's fitness levels in 2010 versus 26% in 2004 [20].

Research Design

Dataset and Sample

To analyze whether Arkansas's Act 1220 affected childhood obesity, the study used data from the state version of the Centers for Disease Control and Prevention's (CDC's) Youth Risk Behavior Survey (YRBS) that included individual-level data on adolescents aged 12-18 attending public schools. When weighted, the data are representative of the population of 9-12th graders in public schools in the state. Data from five years of repeated cross-sections collected during the spring of 1999, 2001, 2005, 2007 and 2009 were used for Arkansas (the treatment state) and Missouri (the comparison state). When pooled across years, the unweighted sample size for Arkansas was 7,492 while for Missouri, it was 7,871. Since the data were de-identified and publicly available, the UC Davis Institutional Review Board (IRB) determined that this study was not human subjects research and exempt from review.

Measures

The main outcome measure was an adolescent's BMI calculated using their self-reported height and weight. This study used both BMI-for-age z-scores (zBMI) as well as an adolescent's classification in three weight categories based on their age and gender adjusted BMI percentiles as follows: (1) healthy weight (5th percentile to < 85th percentile); (2) overweight (85th percentile to < the 95th percentile); and (3) obese (≥ 95th percentile). Prior research has demonstrated high validity between reported height and weight versus actual measured values among YRBS respondents [22]; the correlation between self-reported versus actual measured height was 0.90, while for weight it was 0.93, and for BMI, 0.89. In addition, the CDC percentiles of BMI serve as a strong proxy for actual measured body fat; percentage body fat as measured by Dual energy X-ray absorptiometry (DXA) scans were highly correlated (.88) with BMI percentiles for age and gender [23].

To enhance the precision of the difference-in-difference estimates and to account for demographic differences related to BMI, several controls were included: adolescents' self-reported gender, age, and their racial and ethnic backgrounds. A child's race/ethnicity was coded in four categories: (1) Black non-Hispanic; (2) Hispanic; (3) White non-Hispanic; or (4) a race/ethnicity other than Black, Hispanic, or White (Native American or Alaskan Native, Native Hawaiian or Pacific Islander, or Asian). This last group was treated as the reference group.

Missing data. Less than 1% of observations had missing data on height and weight, gender and age; thus, listwise deletion was used for these analyses under the assumption that data was missing completely at random.

Analytic Strategy

This study used the quasi-experimental method of difference-in-differences [24, 25]. The first difference represented the change in outcomes for cohorts of Arkansas adolescents from before and after the enactment of Act 1220 in 2003. The outcomes, averaged across adolescents across 1999 and 2001 (the before periods) were compared to the average outcomes for adolescents in 2005, 2007 and 2009 (the after periods). Though this difference captured, in part, the influence of Act 1220, it also captured other secular (i.e., time-varying) trends that could also help explain changes in adolescents' weight outcomes.

To net out these secular trends, a second difference was derived across the same time period using data on adolescents from the neighboring state of Missouri as a comparison. Subtracting this second difference from the first difference yielded the difference-in-differences estimator, isolating the effect of Act 1220.

Missouri was a suitable comparison state for three key reasons. First, trends in outcomes between Missouri and Arkansas prior to the enactment of Act 1220 in 2003 did not significantly differ from each other which provided some confidence that such trends would have continued to be similar in the absence of the Act, a critical assumption (i.e., the parallel trends assumption

[26]) underpinning this study's difference-in-differences strategy. This is shown in Table 1, which reports changes in outcomes between 1999 and 2001 for Arkansas and Missouri and whether those changes differed between each state. As reported, none of the changes significantly differed between Arkansas and Missouri at a conventional level of significance (α=.05). Second, adolescents in Missouri were neither affected by the provisions of Act 1220 nor were they subject to policies enacted within Missouri itself that were related to adolescent obesity and concomitant with Arkansas's Act 1220 (based on information in the CDCs State Policy Tracking System). Finally, Missouri's response rate to the YRBS was sufficiently high (60%) to ensure that the data could be appropriately weighted to be representative of adolescents for the years under consideration.

<<insert Table 1 here>>

Regression was used to obtain the difference-in-differences estimator. More formally, the model fit to data for the *i*th child was as follows:

$$Y_i = \alpha + \delta \left(ArkansasAfter2003_i \right) + \theta \left(Arkansas_i \right) + \lambda + \gamma x + \varepsilon_i \qquad (1)$$

where Y_i is the outcome (e.g., zBMI), $ArkansasAfter2003_i$ is an indicator variable identifying adolescents who were in Arkansas after the enactment of Act 1220 in 2003 (coded as 1=in Arkansas after 2003, 0 otherwise) while $Arkansas_i$ is an indicator for whether the adolescent was from Arkansas (=1) or Missouri (=0). λ represents a set of indicators for survey years (with 1999 as the omitted year), **x** is a vector of controls (gender, age and race/ethnicity) and ε_i is the normal disturbance term assumed to have a mean zero and constant variance. δ is the difference-in-difference estimator that captures the effect of Act 1220.

Ordinary Least Squares (OLS) regression was used for models where zBMI was the outcome. For BMI categories, three linear probability models were estimated to capture the probability of being in lower versus higher weight category (healthy weight versus obese; healthy weight versus overweight; overweight versus obese). All models were fit to data using Stata 14.2 [27] and incorporated survey weights to account for the stratified sampling design of the YRBS as well as to adjust for survey nonresponse. Standard errors were estimated using Taylor linearization.

Robustness Checks

Adjustment for Self-Report Bias in Height and Weight. Given that adolescents' self-reported height and weight on the YRBS were prone to bias (on average, respondents overestimated their height by 2.7 inches and underestimated their weight by 3.5 pounds [22]), adolescents' heights and weights were adjusted by these amounts to assess how sensitive the results were to misreporting. Also, given that reporting bias also differed by gender (girls overestimated their height by 2.7 inches, on average, and underestimated their weight by 4.5 pounds, while boys overestimated their height by 2.6 inches and underestimated weight by 2.4 pounds [22]), separate adjustments were also made for boys and girls.

Additional Comparison States. To test the consistency of the difference-in-differences estimates to the choice of Missouri as the comparison state, analyses were re-conducted by using three additional comparison states: South Dakota, Utah and Wisconsin. As with Missouri, these three states: (1) did not enact similar statewide legislation around the time of Act 1220 (as confirmed by data reported in the CDC's State Policy Tracking System); (2) granted permission to the CDC for its YRBS data to be released; (3) had a sufficient response rate (60%) so that the data could be properly weighted to be representative of 9-12th graders in the state; and (4) had trends in outcomes (between 1999 and 2001) that were statistically indistinguishable from the trends for Arkansas. Models were re-estimated using each comparison state, individually, and then the three states, together as a whole.

Results

Table 2 displays weighted descriptive statistics for Arkansas and Missouri prior to Act 1220 (years 1999 and 2001 combined). As shown, adolescents' weight outcomes as well as demographic characteristics were similar, on average, across both states prior to 2003. One exception is that the proportion of adolescents who were obese in Arkansas (11.3%) was significantly higher versus Missouri (9.1%), a difference of 2.2 percentage points (95% confidence interval [CI] [0.49, 3.7]; p<.05).

<<insert Table 2 here>>

Difference-in-difference estimates are presented in Tables 3 and 4. As shown in Table 3, Act 1220 did not significantly influence zBMI across the entire sample of adolescents as well as those classified as overweight or obese. Importantly, the estimates are all close to zero and estimated with a reasonable degree of precision. For instance, for adolescents overall, the average change in zBMI associated with Act 1220 was -0.017 (95% CI [-0.097, 0.063]; p=.68) while for overweight adolescents it was -0.003 (95% CI [-0.043, 0.036]; p=.86) and, finally, for obese adolescents it was -0.010 (95% CI [-0.070, 0.051]; p=.75).

Similarly, as shown in Table 4, difference-in-differences estimates for the effect of Act 1220 on the probabilities of being in a lower versus a higher weight category are not significantly different from zero. For example, while the probability of being a healthy weight versus overweight was predicted to be lower by 1.1 percentage points (-0.011; 95% CI [-0.045, 0.023]; p=.51) and the probability of being a healthy weight versus obese was 1.5 percentage points higher (0.015; 95% CI [-0.017, 0.046]; p=.35), neither of these associations are statistically significant and therefore zero effects cannot be ruled out.

<<insert Table 3 here>>

<<insert Table 4 here>>

Robustness Checks

Adjusted BMI. As shown in Supplementary Table A (included in the online supplement), results using BMIs that were adjusted for self-report bias in height and weight, overall and by gender, are consistent with the conclusion that Act 1220 was neither significantly related to adolescents' zBMI nor their probabilities of being in a lower versus higher weight category.

Additional Comparison States. Results using the set of additional comparison states reported in Supplemental Table B (included in the online supplement) show that the main results for zBMI are less precisely estimated versus the results using Missouri as the sole comparison state. Yet, the results still reinforce the conclusion that Act 1220 was unrelated to adolescents' BMI.

Using Utah and South Dakota as comparison states, the probabilities of being healthy weight were significantly higher due to Act 1220. Also, when treating South Dakota as a comparison to Arkansas, the probability of being healthy versus obese was higher. However, given a total of 24 statistical tests (6 outcomes across 4 different comparison group scenarios) none of these 3 effects are significant at a more stringent significance level (α=.002) to account for multiple hypothesis testing. Thus, these results do not appear to be sensitive to the choice of Missouri as the comparison state.

Discussion

Using the method of difference-in-differences, this study did not detect a significant effect of Arkansas's Act 1220—one of the earliest statewide policy initiatives to address childhood obesity via schools—on adolescents' zBMI or their probabilities of being in a lower versus higher weight category. Though there is no consensus about reductions in zBMI that would be deemed clinically significant for adolescents, prior research has used reductions of .25 or greater as a benchmark which is based on findings that a reduction of .25 or more in a sample (n=88) of obese adolescents (median age=12.4 years) in the United Kingdom was associated with improved body composition and lowered cardiovascular risk [28]. In this study, given a 95% CI of -.070 to .051 for the association, on average, between Act 1220 and obese adolescents' zBMI, even a clinically significant reduction (≥.25) would be highly implausible. Accordingly, these findings are noteworthy as they are the first to suggest that obese and overweight adolescents' weight outcomes were unaffected by Act 1220. Importantly, given the infeasibility of conducting a randomized controlled trial to evaluate a statewide antiobesity policy such as Act 1220, a key strength of this study was that it leveraged the quasi-experimental design of difference-in-differences to control for changes over time using the comparison state of Missouri.

There are several important takeaways of this study. Though no relationship was detected in this study, these results do not suggest that all statewide policy initiatives to prevent childhood obesity via schools are, on the whole, ineffective. What may matter for their effectiveness is the specific kinds of policies that states can reasonably implement with strong fidelity in local school settings. For instance, recent research on the impact of statewide policies that regulate foods and beverages in public schools—known as competitive food and beverage (CF&B) policies [29]—showed that adolescents exposed to a range of CF&B policies, including regulations on vending machines and foods sold via school fundraisers, were strongly related to lowering the odds of being overweight or obese relative to having no policy at all [30]. Importantly, the number of policies mattered. Children in states with seven or more CF&B policies had a lower BMI as well as a probability of being obese/overweight relative to those residing in states with five or fewer policies. As compared to Act 1220, which had only one CF&B policy (vending machine regulations) that only applied to younger elementary aged children, this suggests that the limited influence of Act 1220 on adolescents may have been related to its limited set of CF&B provisions targeting middle and high schools.

Finally, this study's findings should be interpreted in the broader context of evidence that has been shown to reduce childhood obesity. A systematic review of 124 interventions conducted by the Johns Hopkins University Evidence-based Practice Center showed that two kinds of interventions had *high evidence* of effectiveness in preventing obesity or overweight in children [31]. High evidence meant that further research on these interventions would not substantially alter the conclusion that the intervention was effective. These two intervention types were: (1) school-based interventions that combined physical activity and diet with a home-based component; and (2) school-based physical activity and diet interventions that were combined with a home and community component. In contrast to these multifaceted interventions, school-based interventions in isolation had only moderate or insufficient evidence of their effectiveness. A primary take-away of these results: multi-pronged strategies where home and communities worked in tandem with schools were more effective versus a single-pronged school-only approach. Given this, statewide policy initiatives, in and of themselves, such as Arkansas's Act 1220 may be limited in moving the needle on adolescent obesity in ways that can lead to clinically significant changes in weight outcomes—what may matter more is how state policies work in tandem with more localized approaches that acknowledge the influential role of families and communities in shaping children's dietary and physical activity behaviors.

Limitations

Though this study's difference-in-differences strategy attempted to provide a strong counterfactual by using Missouri as a comparison condition, and as argued, the parallel trends assumption held for this study, unobserved time-varying differences were not controlled for. Further, the study assumes that other characteristics such as neighborhood socio-economic status remained stable over time. Also, this study assumed that the population of 9-12th graders surveyed at each wave did not systematically migrate to Arkansas from Missouri or vice versa due to reasons related to Act 1220. Finally, these results should not be generalized to other states or younger age groups such as elementary school-aged children.

Conclusion

Within the past decade, statewide initiatives to address obesity via schools have gained traction and momentum across the country. This study generates new evidence that a statewide policy initiative implemented in Arkansas in 2003 to prevent childhood obesity via schools, known as Act 1220, was unrelated to adolescents’ weight outcomes. Importantly, these results suggest that combatting adolescent obesity is unlikely to occur through such large-scale policy initiatives alone; rather, as extant research has shown, localized school-based approaches with home and community-based components are critical in the ongoing fight against childhood obesity [31].

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Tables

Table 1. Changes in Weight Outcomes Between Arkansas and Missouri Prior to the Implementation of Act 1220 in 2003

Outcome	Arkansas (Change From 1999 to 2001)	Missouri (Change From 1999 to 2001)	Difference in Changes Arkansas vs. Missouri	95% CI
BMI-for-age z-score (zBMI)	0.09	0.03	0.06	[-0.09, 0.22]
Healthy Weight (%)	-3.61	-4.66	1.05	[-5.95, 8.00]
Overweight (%)	1.76	0.63	1.13	[-4.26, 6.50]
Obese (%)	1.85	3.99	-2.14	[-6.54, 2.25]

Source: Author's analysis of data from the Youth Risk Behavior Survey for Arkansas and Missouri, 1999 and 2001.
Notes: Based on results of ordinary least squares (OLS) regressions of each outcome on indicators for state (Arkansas or Missouri), year (1999 or 2001) and their interaction. Estimates reported are on the interaction terms from each model. All regression models included survey weights and variance estimation was based on Taylor linearization.

Table 2. Weighted Descriptive Statistics (Percentages or Means and 95% CIs) for Sample Adolescents Prior to the Implementation of Act 1220

	Arkansas 9th-12th Graders (1999 & 2001) ($n_{unweighted}$ = 2913)		Missouri 9th-12th Graders (1999 & 2001) ($n_{unweighted}$ = 3099)		*p* value
	Percentage or Mean	95% CI	Percentage or Mean	95% CI	
BMI-for-age z-score (zBMI)	0.49	[0.45, 0.54]	0.44	[0.40, 0.49]	0.12
Healthy weight	68.18	[65.77, 70.59]	70.75	[68.50, 73.02]	0.14
Overweight	20.51	[19.01, 22.00]	20.12	[18.29, 21.95]	0.69
Obese	11.31	[9.82, 12.80]	9.12	[8.11, 10.12]	**0.01**
Race/ethnicity					
Other	3.71	[2.86, 4.56]	3.54	[2.30, 4.78]	0.76
Black	19.49	[14.52, 24.46]	19.73	[8.33, 31.14]	0.96
White	74.65	[69.82, 79.48]	75.28	[63.90, 86.66]	0.91
Hispanic	2.14	[1.43, 2.86]	1.45	[0.53, 2.36]	0.15
Male	51.34	[48.79, 53.90]	51.18	[47.83, 54.53]	0.94
Age (in years)	16.14	[15.95, 16.34]	16.24	[16.11, 16.35]	0.35

Source: Author’s analysis of data from the Youth Risk Behavior Survey for Arkansas and Missouri, 1999 and 2001.
Notes: Reported *p*-values based on ordinary least squares (OLS) regressions of each outcome on an indicator for state (Arkansas or Missouri). Regression models incorporated survey weights while standard errors were estimated using Taylor linearization. P-values in bold indicate statistical significance ($p<.05$).

Table 3. Difference-in-differences Estimates for the Effect of Arkansas's Act 1220 on Adolescents' BMI-for-age z-scores (zBMI)

	Overall	Overweight Group	Obese Group
Difference-in-differences estimator	-0.017	-0.003	-0.010
	[-0.097, 0.063]	[-0.043, 0.036]	[-0.070, 0.051]
Year (ref: 1999)			
2001	0.066	0.010	-0.014
	[-0.002, 0.134]	[-0.024, 0.044]	[-0.073, 0.044]
2005	0.174***	0.007	0.021
	[0.099, 0.249]	[-0.034, 0.049]	[-0.051, 0.093]
2007	0.105***	0.016	0.015
	[0.056, 0.154]	[-0.021, 0.053]	[-0.069, 0.099]
2009	0.138***	0.001	0.013
	[0.070, 0.206]	[-0.047, 0.048]	[-0.060, 0.085]
Arkansas	0.050	-0.002	0.032
	[-0.012, 0.112]	[-0.027, 0.023]	[-0.017, 0.080]
Race/ethnicity (ref: Other race/ethnicity			
Black	0.260***	-0.019	-0.006
	[0.178, 0.342]	[-0.053, 0.015]	[-0.066, 0.054]
White	-0.029	0.006	-0.037
	[-0.090, 0.031]	[-0.023, 0.035]	[-0.083, 0.010]
Hispanic	0.141*	-0.005	-0.024
	[0.023, 0.260]	[-0.071, 0.062]	[-0.119, 0.071]
Male	0.227***	0.059***	0.177***
	[0.192, 0.263]	[0.041, 0.078]	[0.151, 0.203]
Age (in years)	-0.049***	-0.032***	-0.019***
	[-0.065, -0.033]	[-0.038, -0.025]	[-0.030, -0.008]
Constant	1.057***	1.809***	2.353***
	[0.809, 1.305]	[1.697, 1.922]	[2.145, 2.561]
Observations	15119	3170	1694

(unweighted)

*$p<.05$; **$p<.01$; ***$p<.001$; 95% CI in brackets.
Source: Youth Risk Behavior Survey (1999, 2001, 2005, 2007 & 2009) for Arkansas and Missouri
Notes: Models incorporate survey weights and standard errors based on Taylor linearization. Other race/ethnicity refers to children who self-identify as Native American or Alaskan Native; Native Hawaiian or Pacific Islander; or Asian.

Table 4. Adjusted Difference-in-differences Estimates for the Effect of Arkansas's Act 1220 on Adolescents' Probability of Being in a Lower versus Higher Weight Category

	Pr(healthy weight v. overweight)	Pr(healthy weight v. obese)	Pr(overweight v. obese)
Difference-in-differences estimator	-0.011	0.015	0.047
	[-0.045, 0.023]	[-0.017, 0.046]	[-0.005, 0.099]
Year (ref: 1999)			
2001	-0.025	-0.046***	-0.064*
	[-0.057, 0.006]	[-0.072, -0.021]	[-0.122, -0.005]
2005	-0.042*	-0.068***	-0.089**
	[-0.082, -0.002]	[-0.094, -0.043]	[-0.154, -0.024]
2007	-0.021	-0.042**	-0.065*
	[-0.050, 0.007]	[-0.068, -0.015]	[-0.114, -0.016]
2009	-0.023	-0.068***	-0.110***
	[-0.050, 0.005]	[-0.092, -0.045]	[-0.156, -0.064]
Arkansas	-0.010	-0.028*	-0.047**
	[-0.036, 0.016]	[-0.052, -0.004]	[-0.080, -0.015]
Race/ethnicity (ref: Other race/ethnicity			
Black	-0.047**	-0.057**	-0.053
	[-0.081, -0.013]	[-0.092, -0.022]	[-0.133, 0.026]
White	0.026	0.016	-0.007
	[-0.005, 0.057]	[-0.014, 0.046]	[-0.073, 0.059]
Hispanic	-0.030	-0.017	-0.008
	[-0.087, 0.028]	[-0.077, 0.044]	[-0.125, 0.109]
Male	-0.066***	-0.068***	-0.050**
	[-0.086, -0.046]	[-0.082, -0.055]	[-0.080, -0.021]
Age (in years)	0.002	-0.009*	-0.019**
	[-0.005, 0.009]	[-0.015, -0.002]	[-0.030, -0.007]

Constant	0.781*** [0.648, 0.914]	1.079*** [0.967, 1.191]	1.079*** [0.884, 1.274]
Observations (unweighted)	13426	11950	4864

**p*<.05; ***p*<.01; ****p*<.001; 95% CI in brackets.
Source: Author's analysis of data from the Youth Risk Behavior Survey for Arkansas and Missouri, 1999, 2001, 2005, 2007 and 2009.
Notes: Models incorporate survey weights and standard errors based on Taylor linearization. Other race/ethnicity refers to children who self-identify as Native American or Alaskan Native; Native Hawaiian or Pacific Islander; or Asian.
Pr=Probability

Supplementary Table A. Adjusted Difference-in-differences Estimates for the Effect of Arkansas's Act 1220 on Adolescents' BMI-for-age z-scores (zBMI) and the Probabilities of Being in a Lower Versus Higher Weight Category. BMI Adjusted for Self-Report Bias in Height and Weight, Overall and Separately, By Gender.

	Overall	Overweight Group	Obese Group	Pr(healthy weight v. overweight)	Pr(healthy weight v. obese)	Pr(overweight v. obese)
Difference-in-differences estimators (from Table 3)	-0.017 [-0.097,0.063]	-0.003 [-0.043,0.036]	-0.010 [-0.070,0.051]	-0.011 [-0.045, 0.023]	0.015 [-0.017, 0.046]	0.047 [-0.005, 0.099]
Difference-in-differences estimators (BMI adjusted for self-report bias in height and weight, overall)	-0.015 [-0.079,0.049]	0.016 [-0.011,0.044]	-0.025 [-0.074,0.023]	0.010 [-0.031,0.050]	0.014 [-0.033,0.060]	0.008 [-0.045,0.062]
Difference-in-differences estimators (BMI adjusted for self-report bias in height and weight, by gender)	-0.015 [-0.079,0.048]	0.016 [-0.013,0.044]	-0.031 [-0.079,0.018]	0.010 [-0.025,0.045]	0.012 [-0.035,0.059]	0.007 [-0.043,0.056]

Note. Estimates based on models that incorporate survey weights. Standard errors based on Taylor linearization. 95% confidence intervals in brackets.

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